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Ameritech

Celia Nogales
Director - Federal Relations

ORIGINAL

September 10, 1999

EX PARTE OR LATE FILED

Ms. Magalie Roman Salas
Secretary
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

Re: **Ex Parte Statement**
CC Docket 96-45 and 97-160

Dear Ms. Salas:

On Thursday, September 9, 1999, Bill Palmer and Bill Fitzsimmons of LECG and I met with Katie King, Bob Loube, Will Cox and Ted Burmeister of the Accounting Policy Division to discuss the Hybrid Cost Proxy Model. The attached material was used as part of our discussion.

Sincerely,

Celia Nogales

Attachment
cc: K. King
B. Loube
W. Cox
T. Burmeister

HCPM REVIEW

Presented by

LECG-NAVIGANT, INC.

September 9, 1999

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HYBRID COST PROXY MODEL PRESENTATION TO THE FCC COMMON CARRIER BUREAU ACCOUNTING POLICY DIVISION

SEPTEMBER 9, 1999

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3	Detailed Outputs for FLTNMIMN
4	Analysis of Selected Investment Inputs and Optimization Procedures in the Hybrid Cost Proxy Model

TAB 1

HCPM REVIEW

PRESENTED TO FCC COMMON CARRIER BUREAU
ACCOUNTING POLICY DIVISION
SEPTEMBER 9, 1999

AGENDA

1. **DISCUSSION OF ADDITIONAL EXCHANGE MAPS**
   - Maps with Streets and Highways
   - Maps with Census Block Boundaries
   - Actual Facility Map (Fulton, Michigan)
   - Electronic Versions of Maps

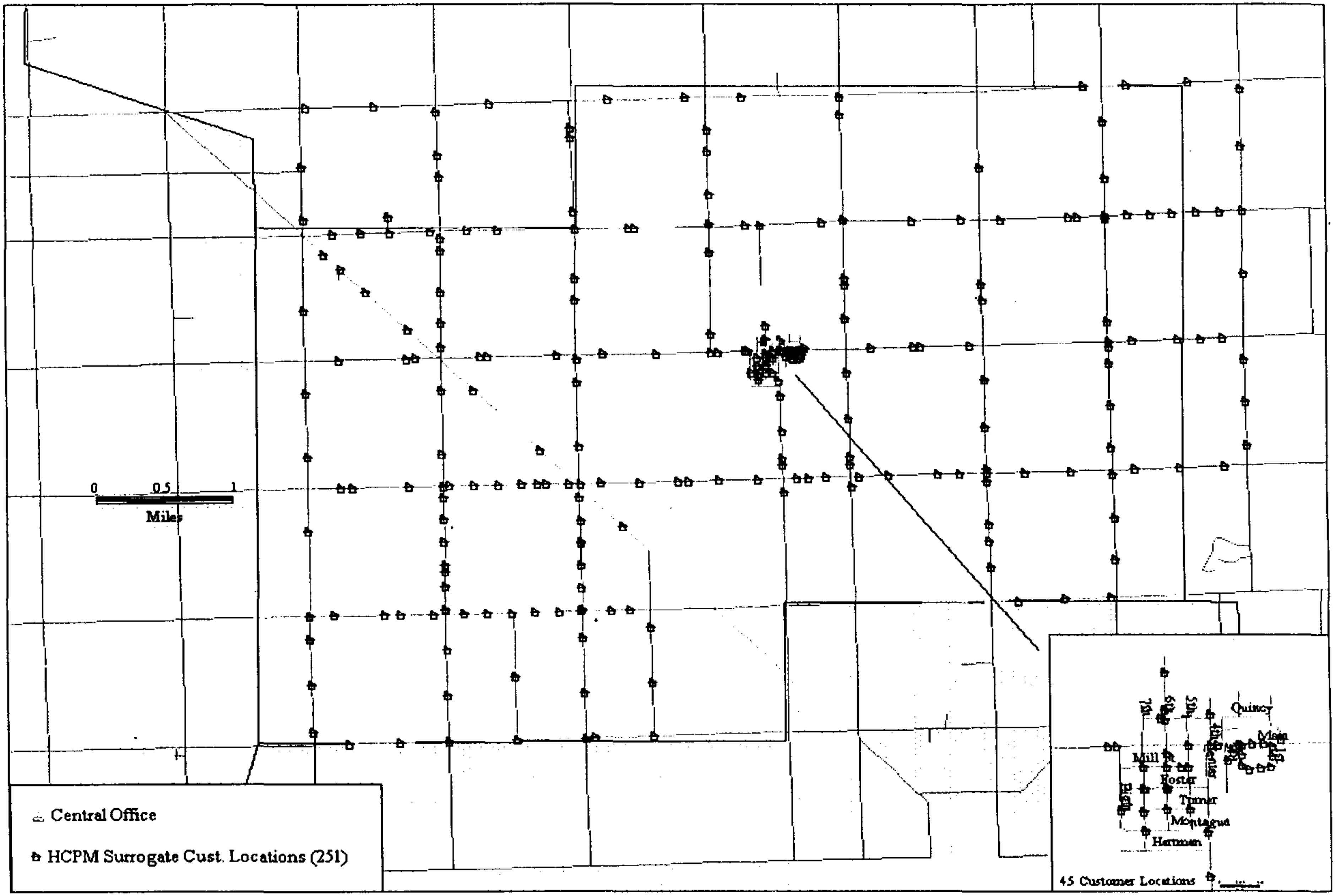
2. **CONSISTENCY AND OPTIMIZATION**

3. **ALIGNMENT WITH COST MODEL PROCESS**

4. **MISCELLANEOUS ISSUES**
   - National Average vs. State-Specific Data
   - Cable Costs
   - Plant Mix
   - Structure Sharing
   - Switching
   - Expenses

TAB 2

Owendale (OWNDMIMN) : 265 Lines



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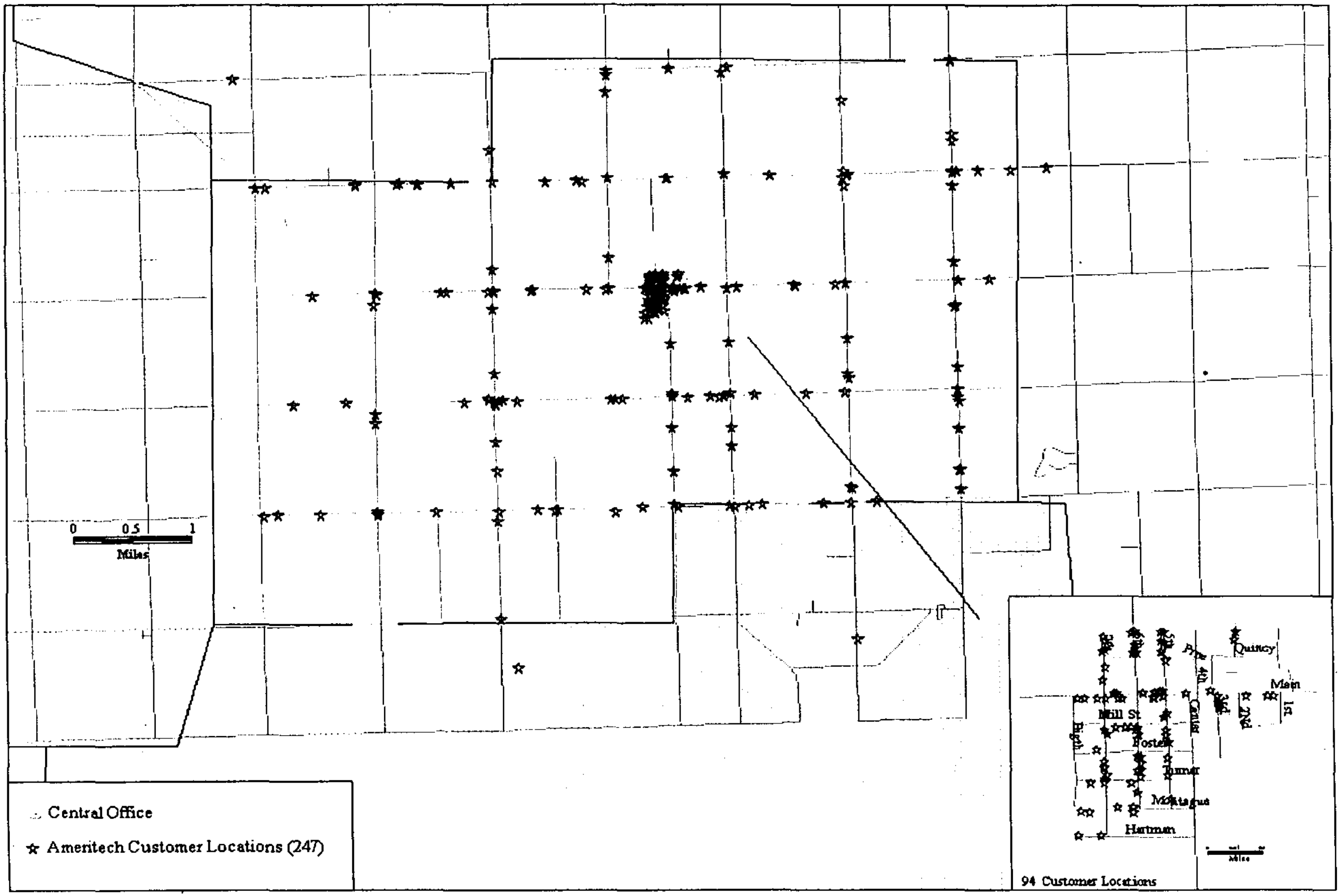
07/14/99

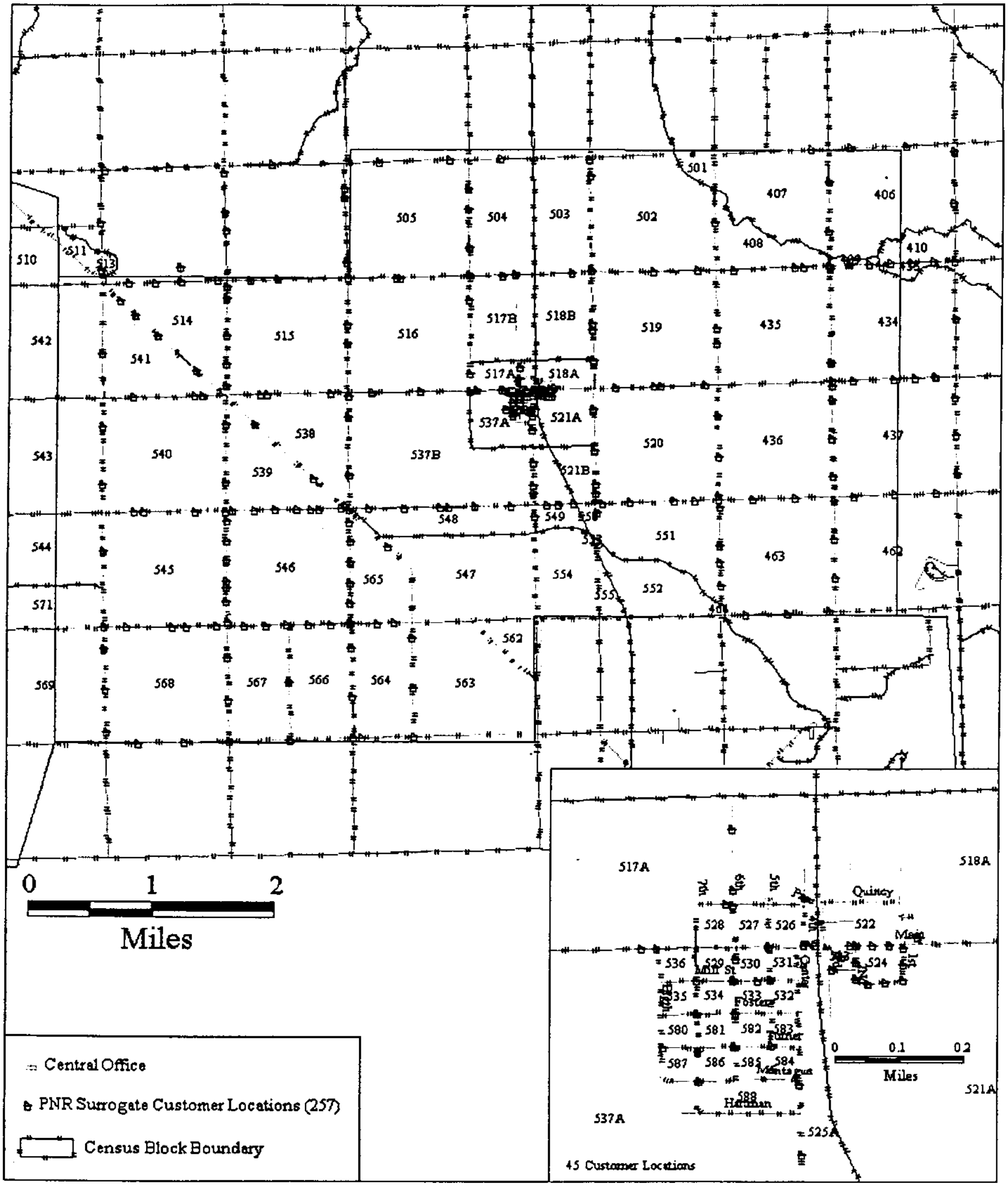
Owendale (OWNDMIMN) : 265 Lines



LECG

07/14/99

Owendale (OWNDMIMN): 256 Lines



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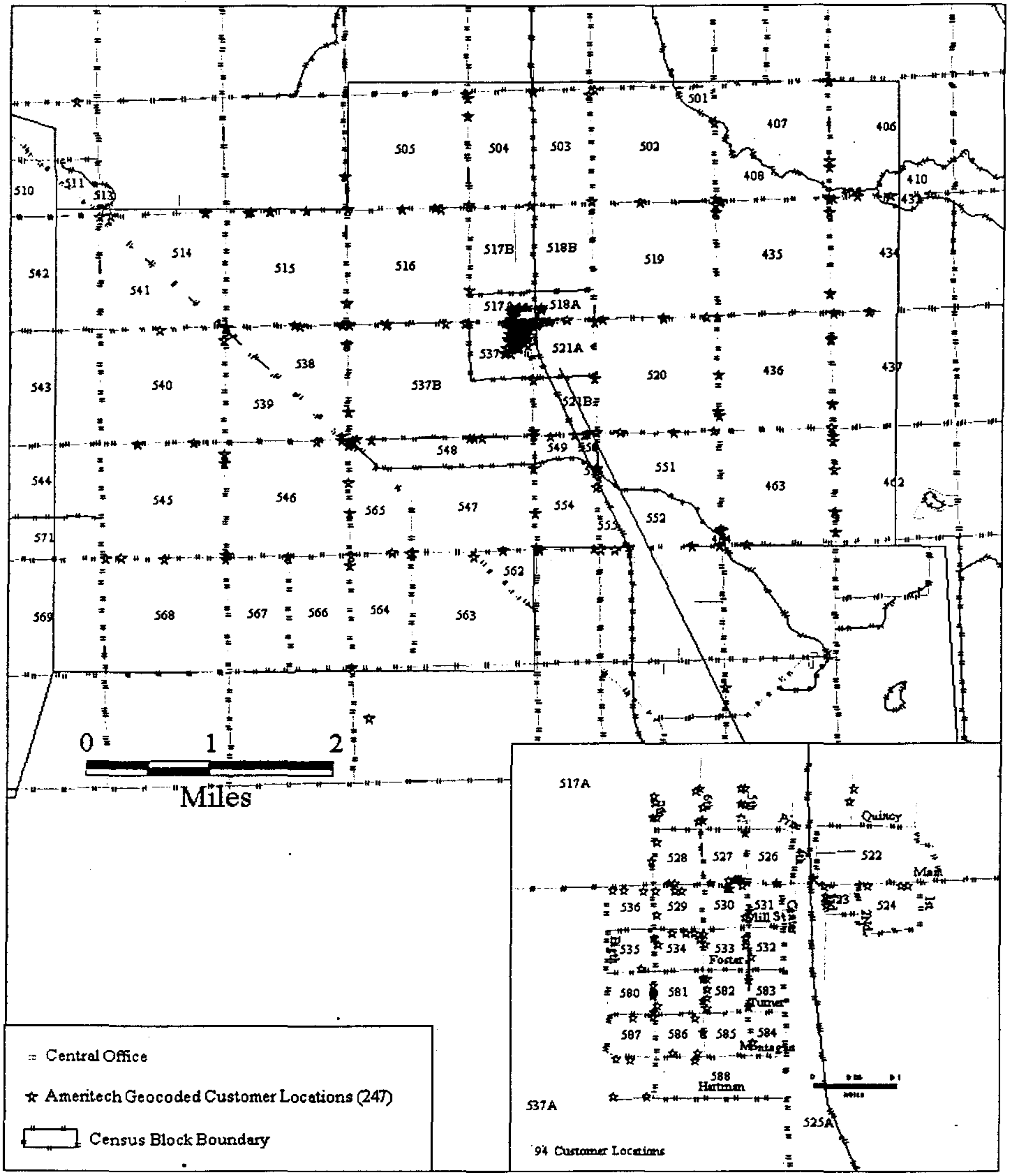
07/20/99

Owendale (OWNDMIMN): 265 Lines



= Central Office

☆ Ameritech Geocoded Customer Locations (247)

Census Block Boundary

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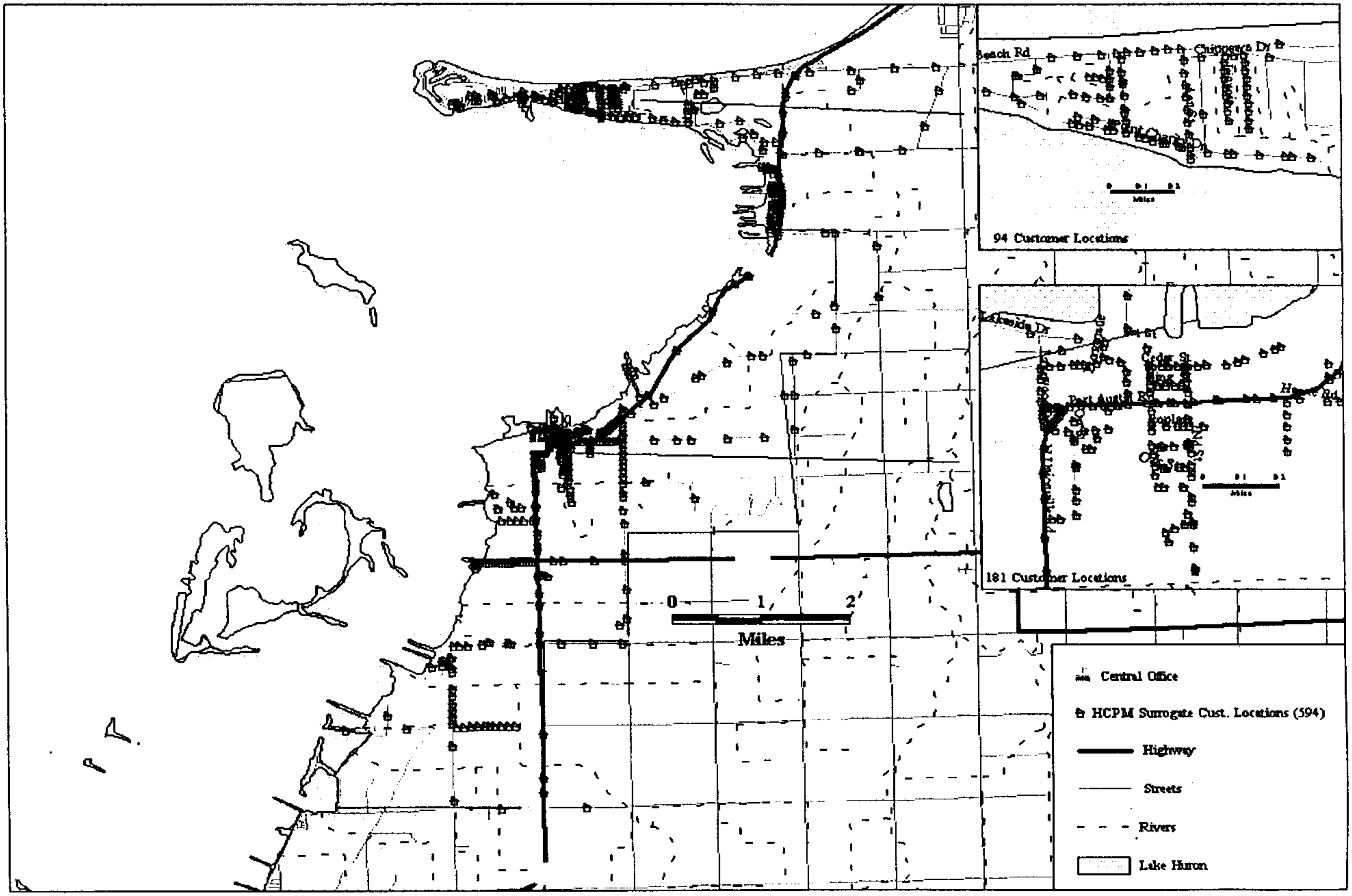
Bayport (BYPTMIMN) : 454 Lines



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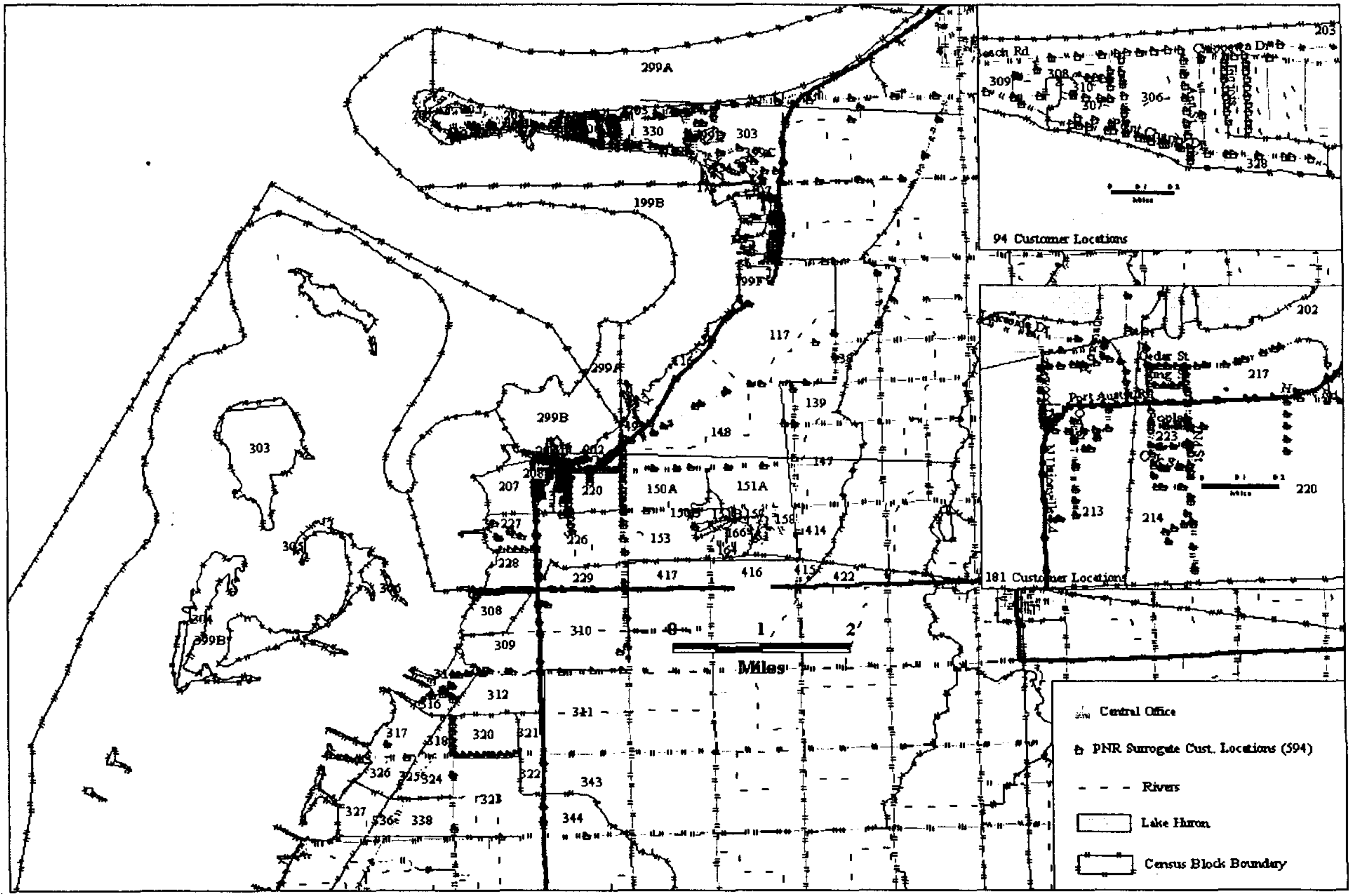
Bayport (BYPTMIMN) : 454 Lines



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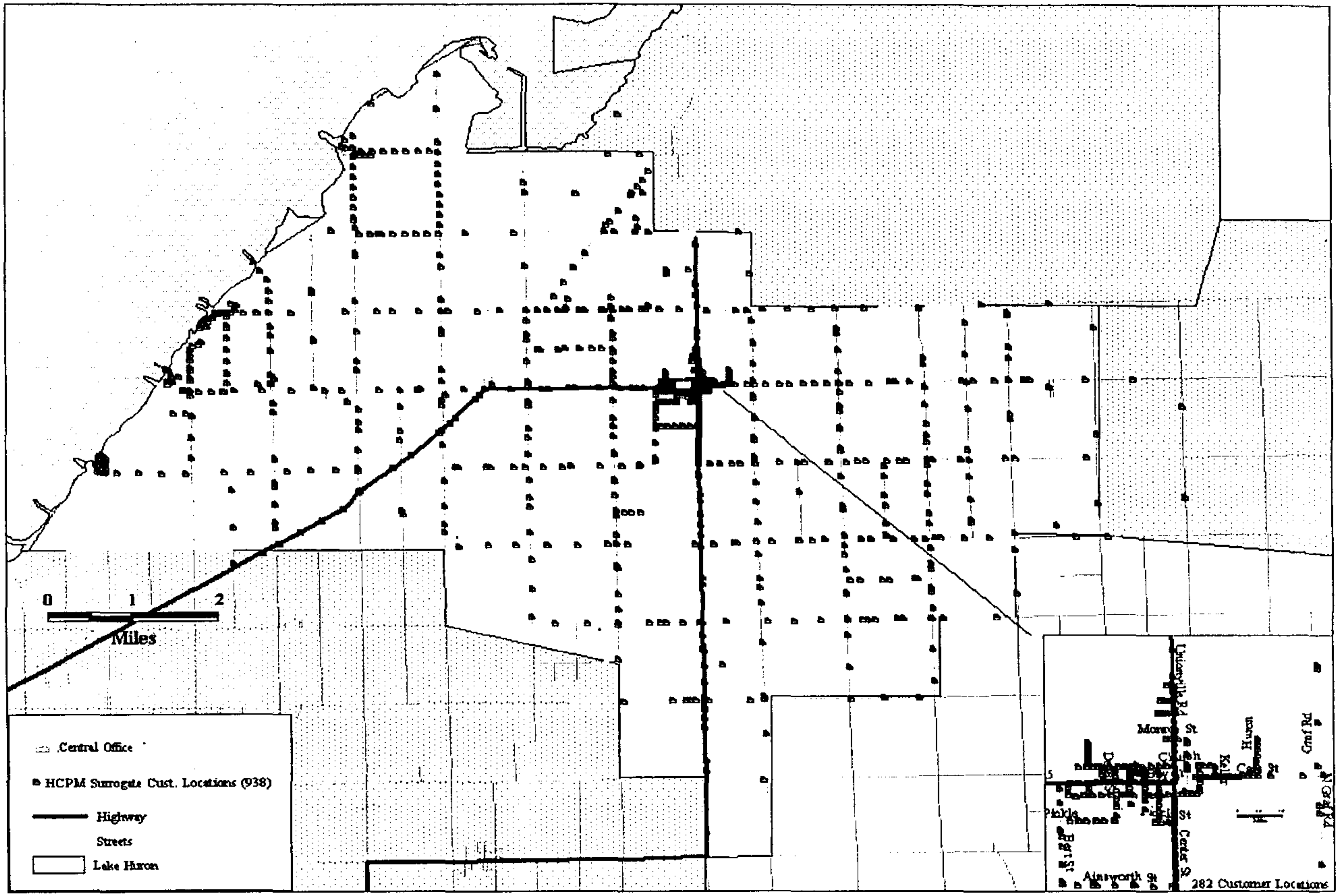
Unionville (UNVLMIMN): 1,000 Lines



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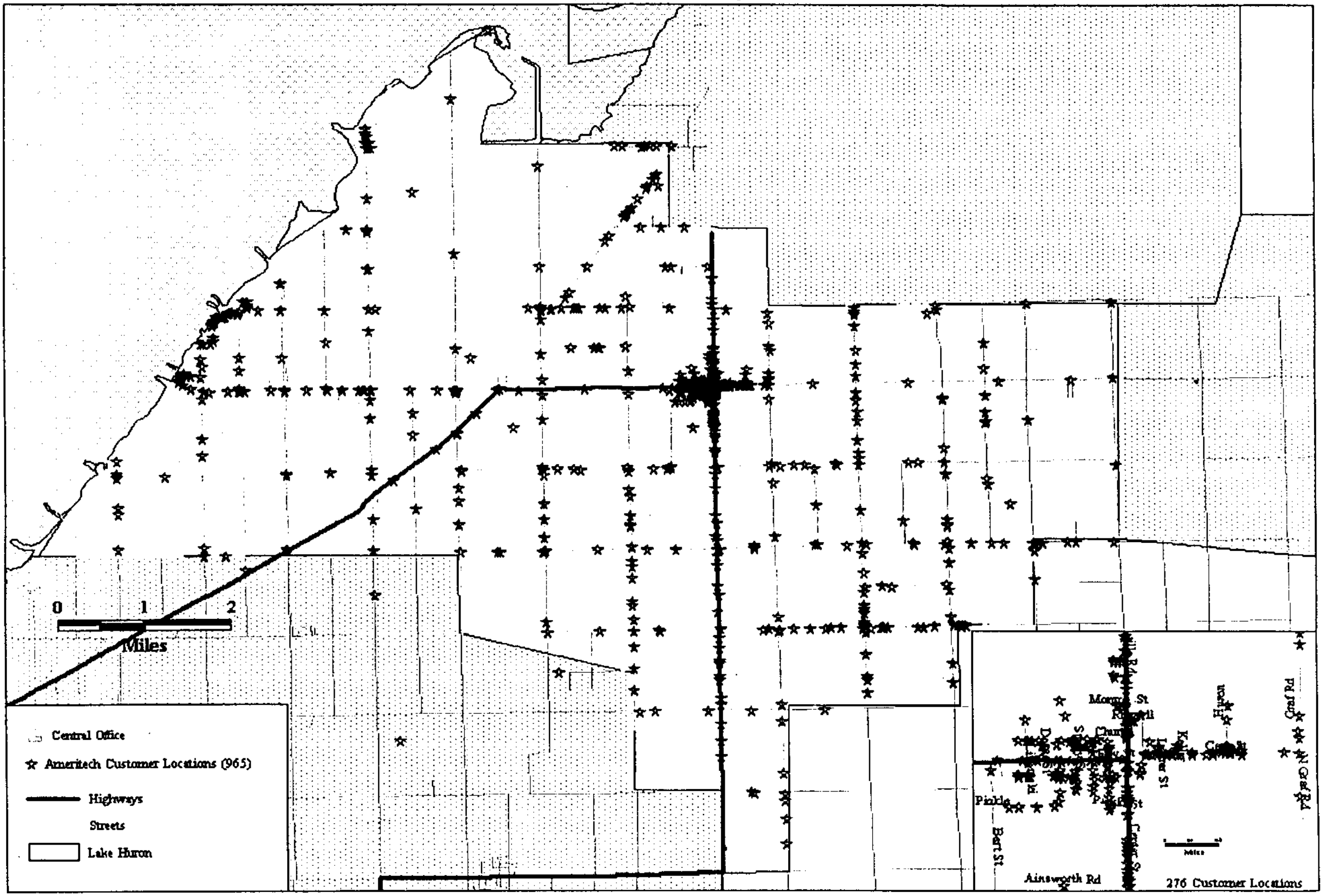
Unionville (UNVLMIMN) : 1,000 Lines



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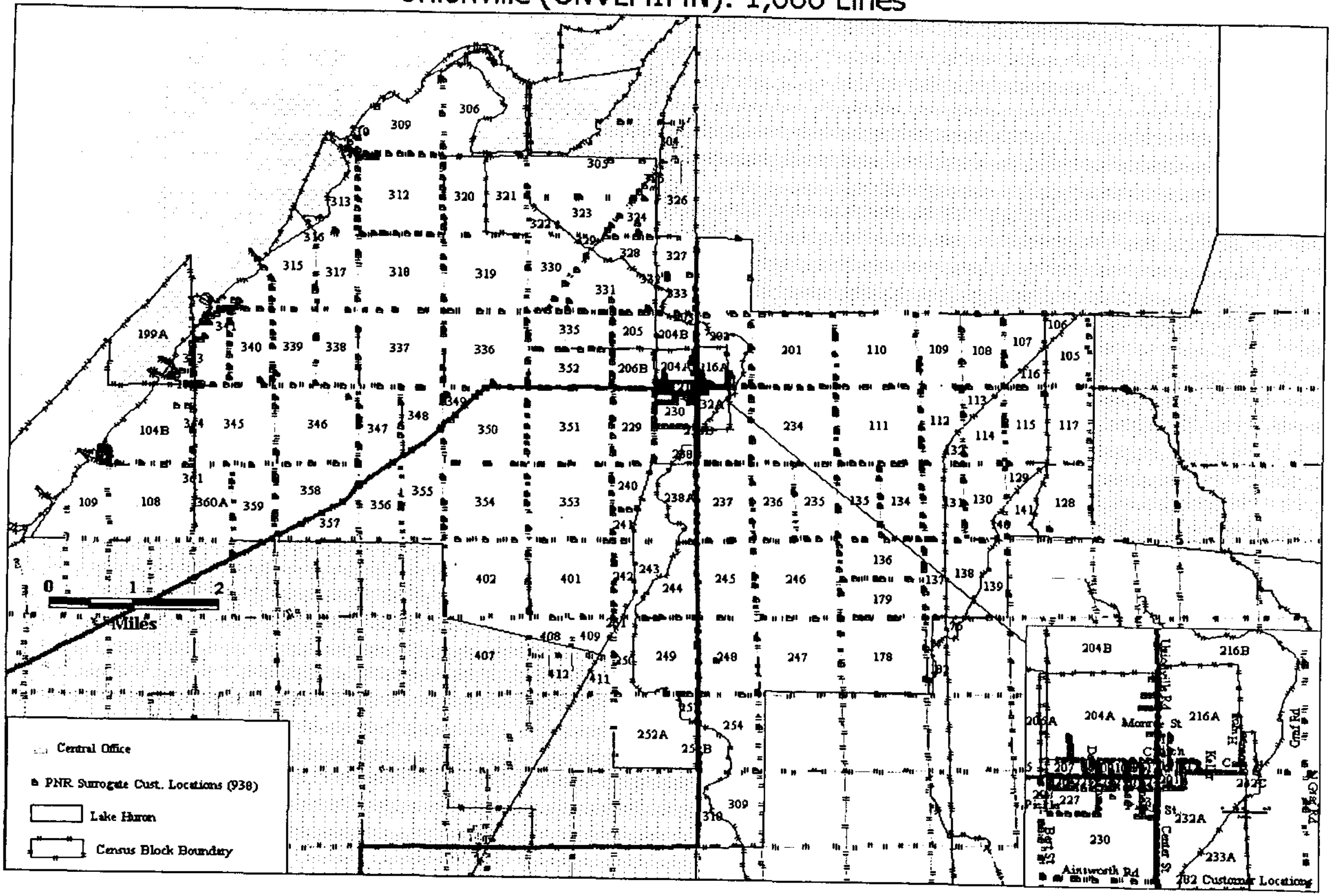
Unionville (UNVLMIMN): 1,000 Lines



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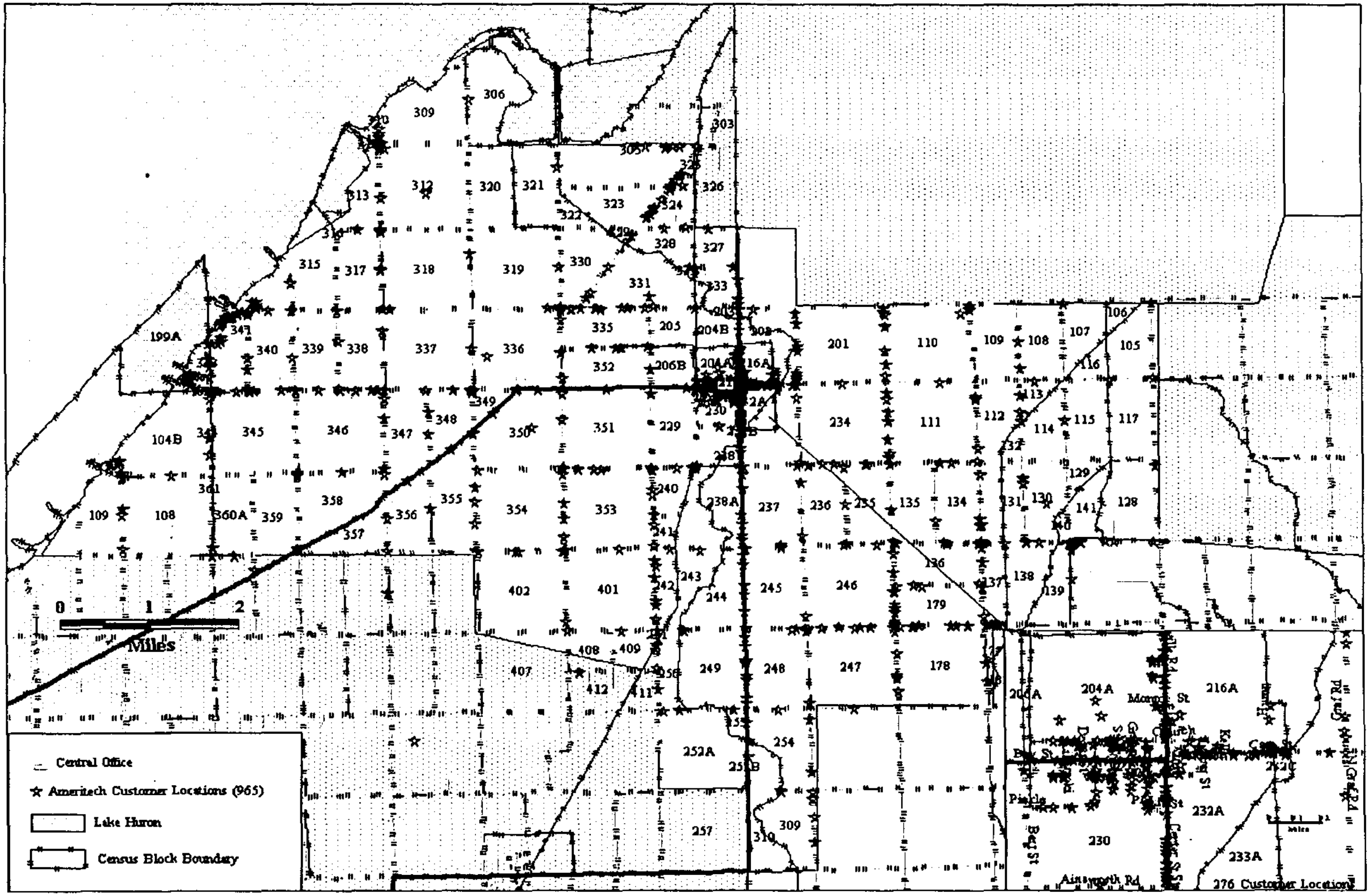
07/20/99

Unionville (UNVLMIMN) : 1,000 Lines



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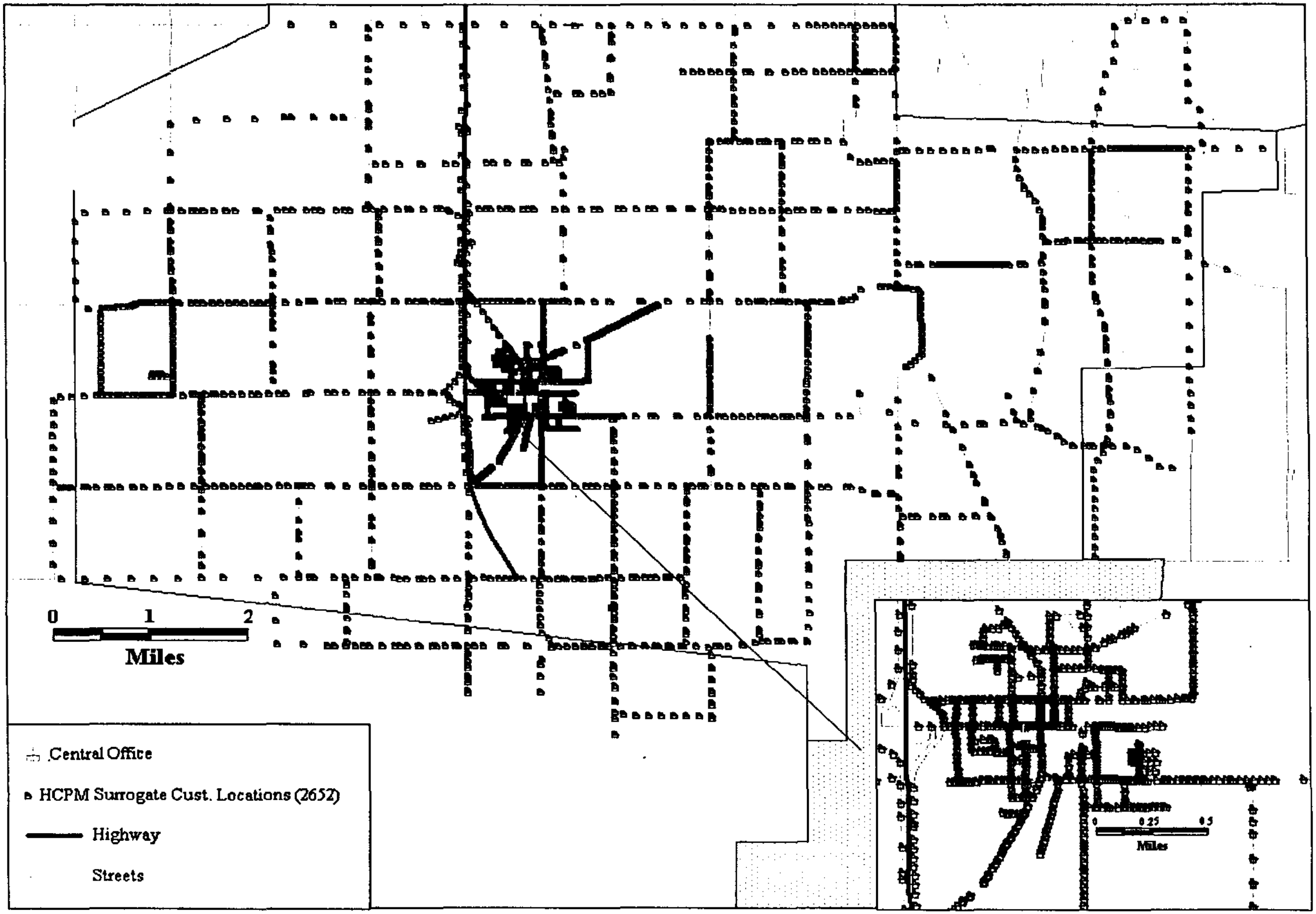
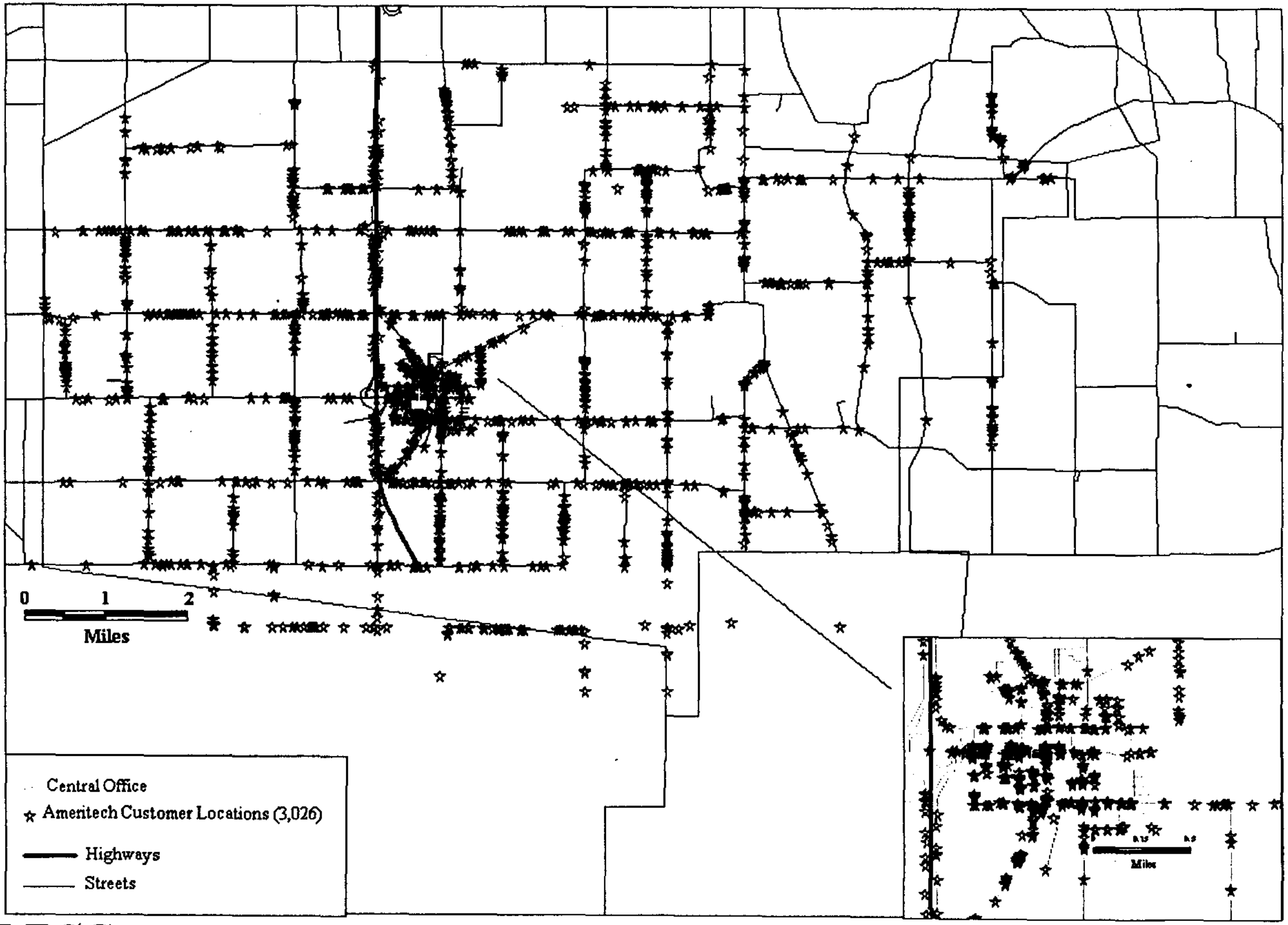
Leslie (LESLMIMN) : 3,039 Lines



LECG

07/14/99

Leslie (LESLMIMN) : 3,039 Lines



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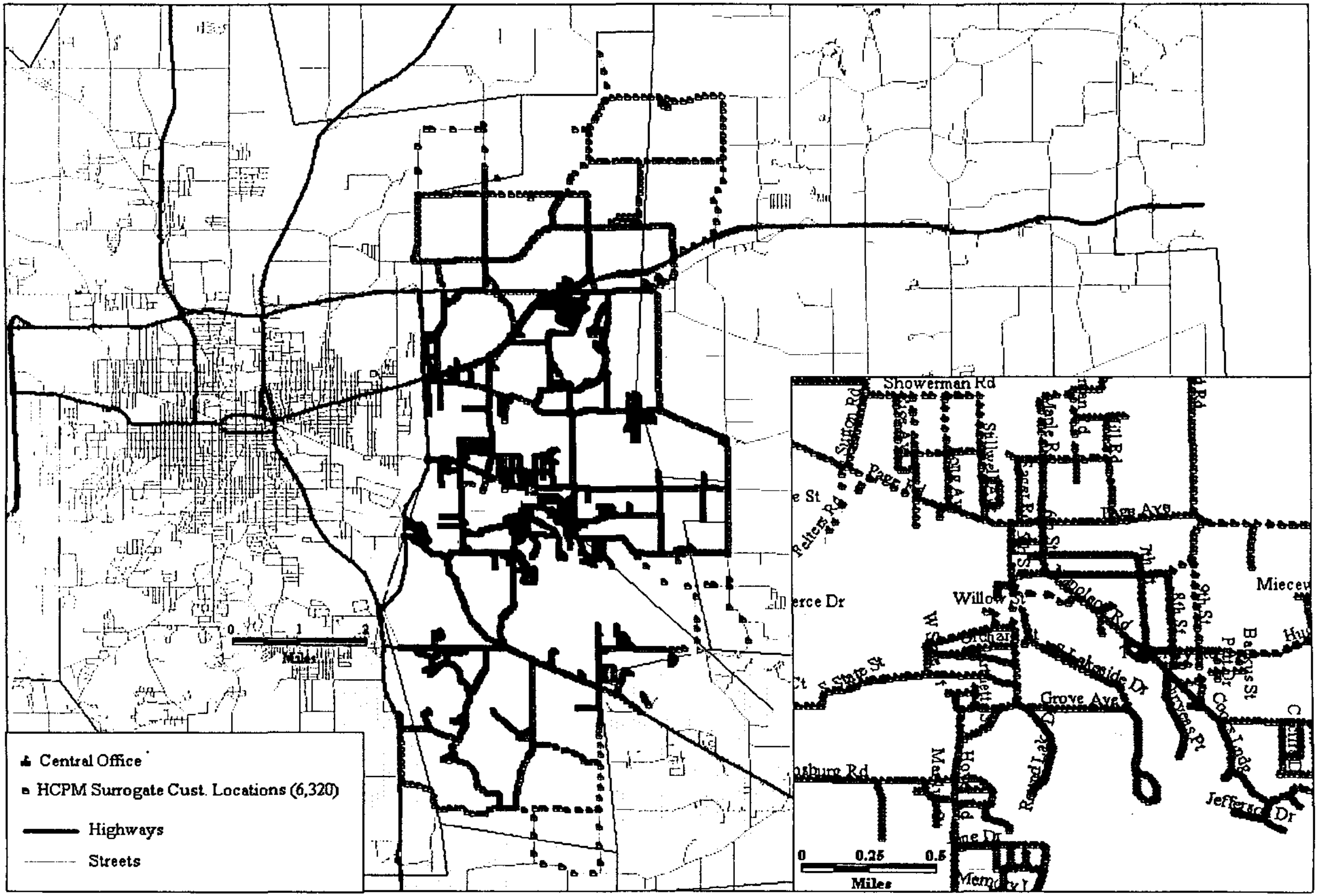
Michigan Center (MCHMIMN): 7,286 Lines



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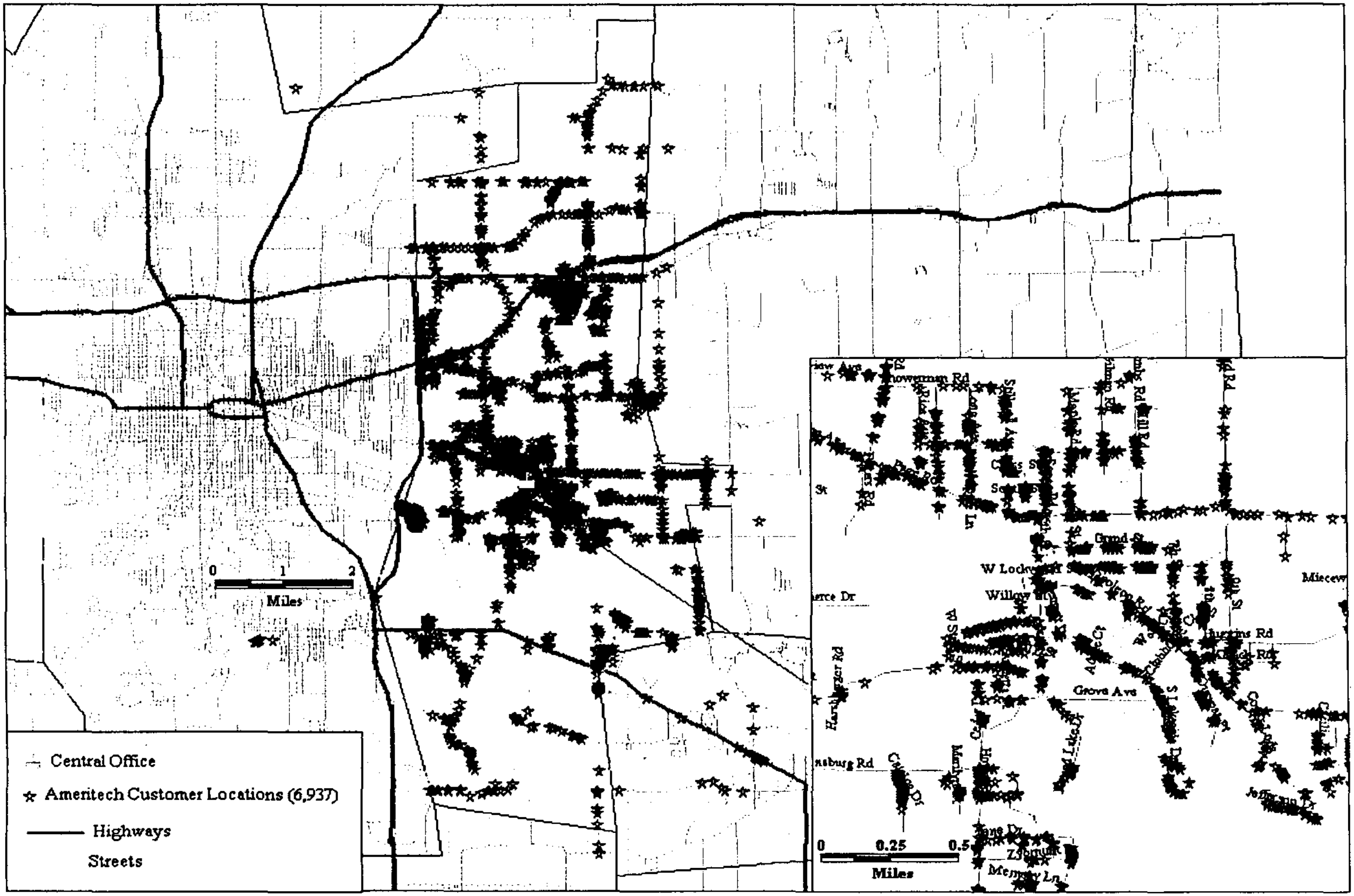
Michigan Center (MCHMIMN): 7,286 Lines



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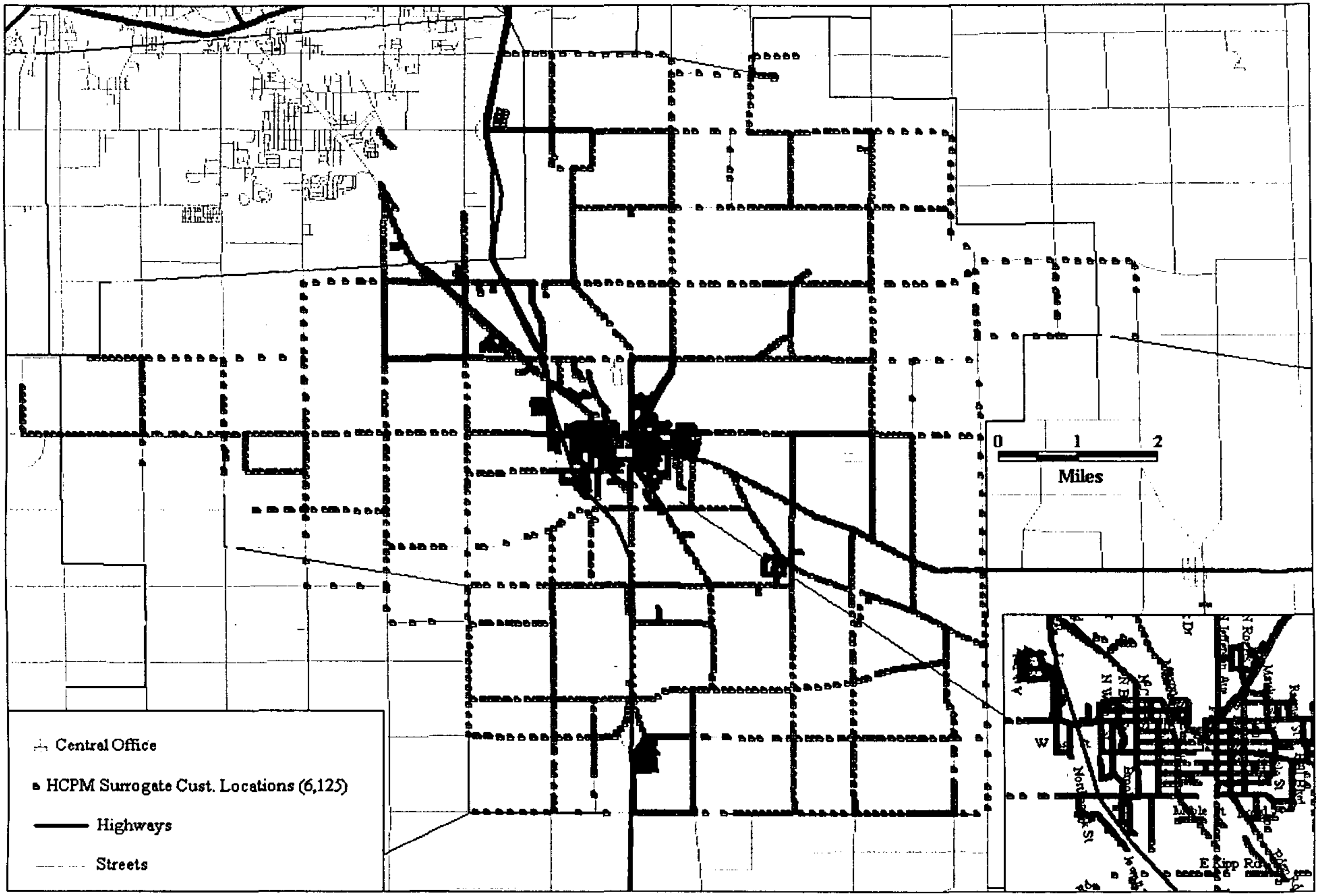
Mason (MASNMIMS): 8,458 Lines



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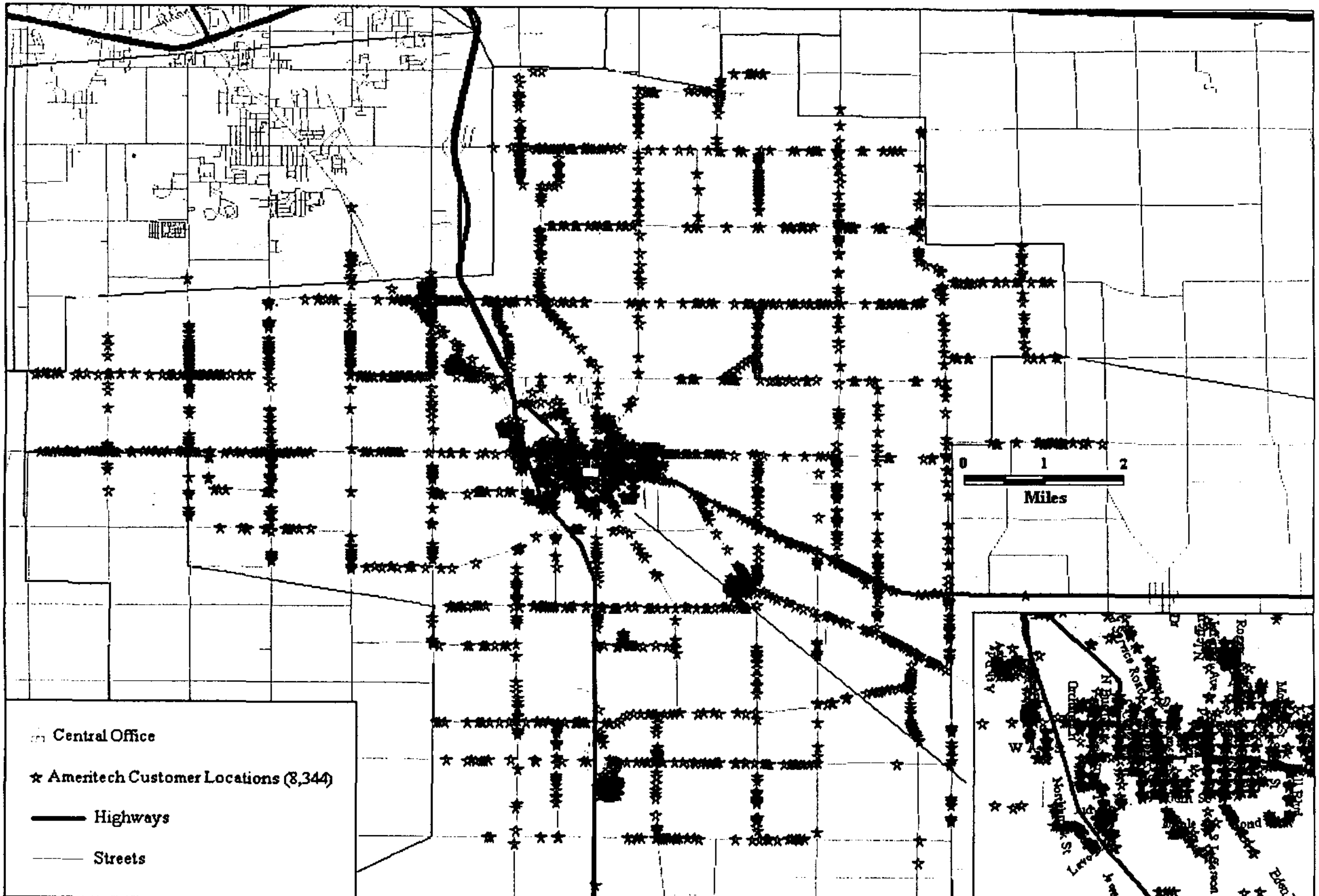
07/14/99

Mason (MASNMIMS) : 8,458 Lines



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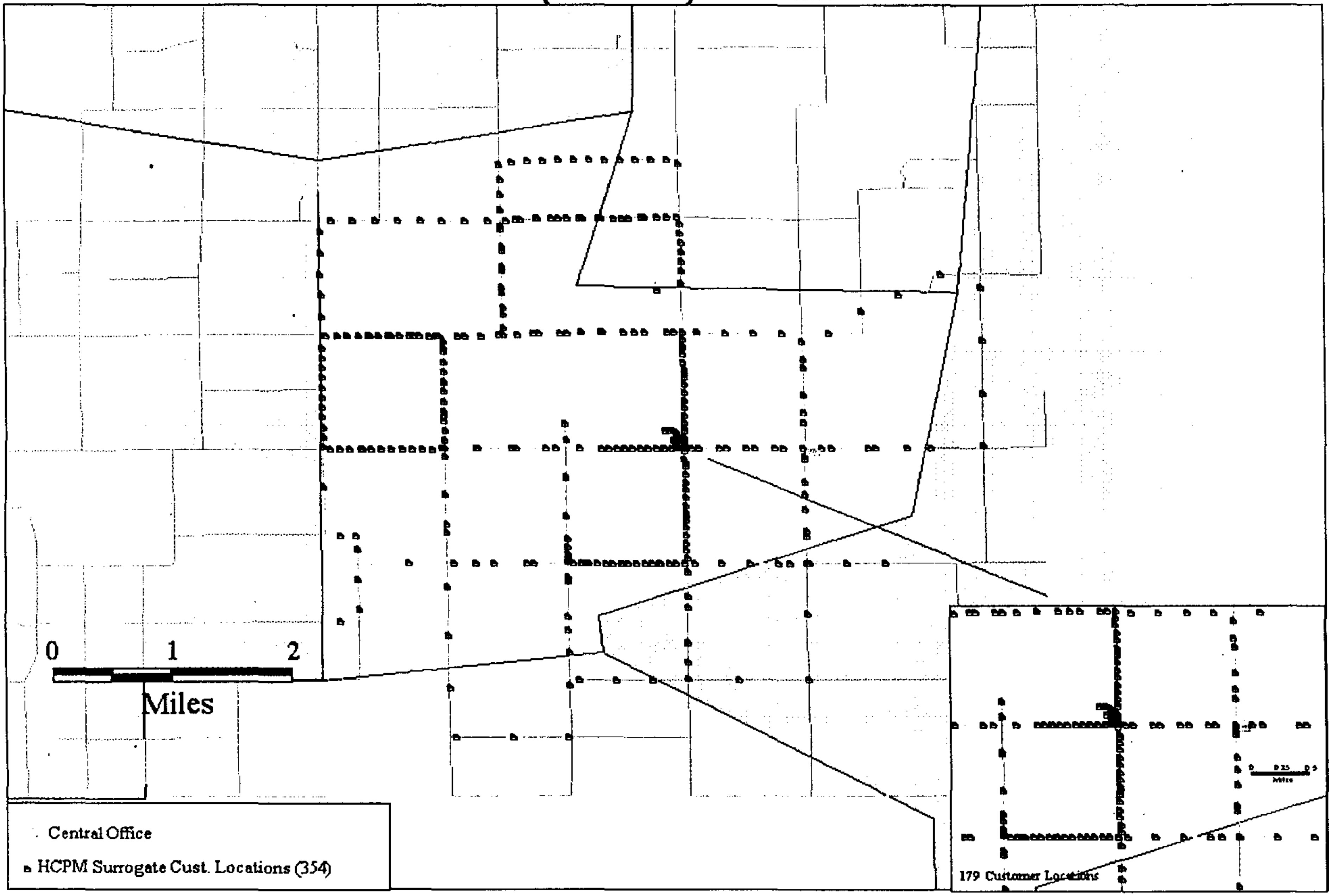
Fulton (FLTNMIN) : 367 Lines



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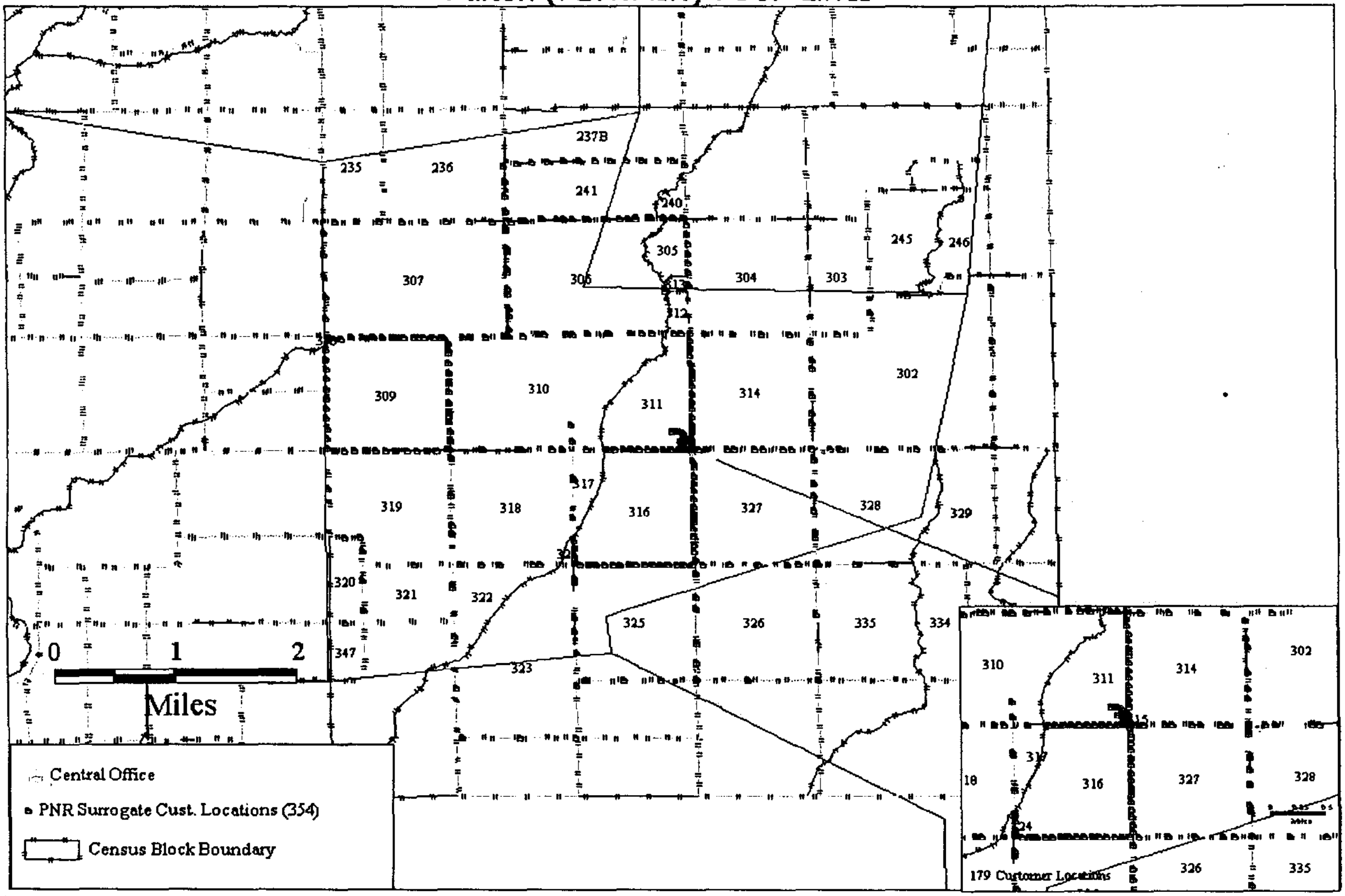
Fulton (FLTNMIN) : 367 Lines



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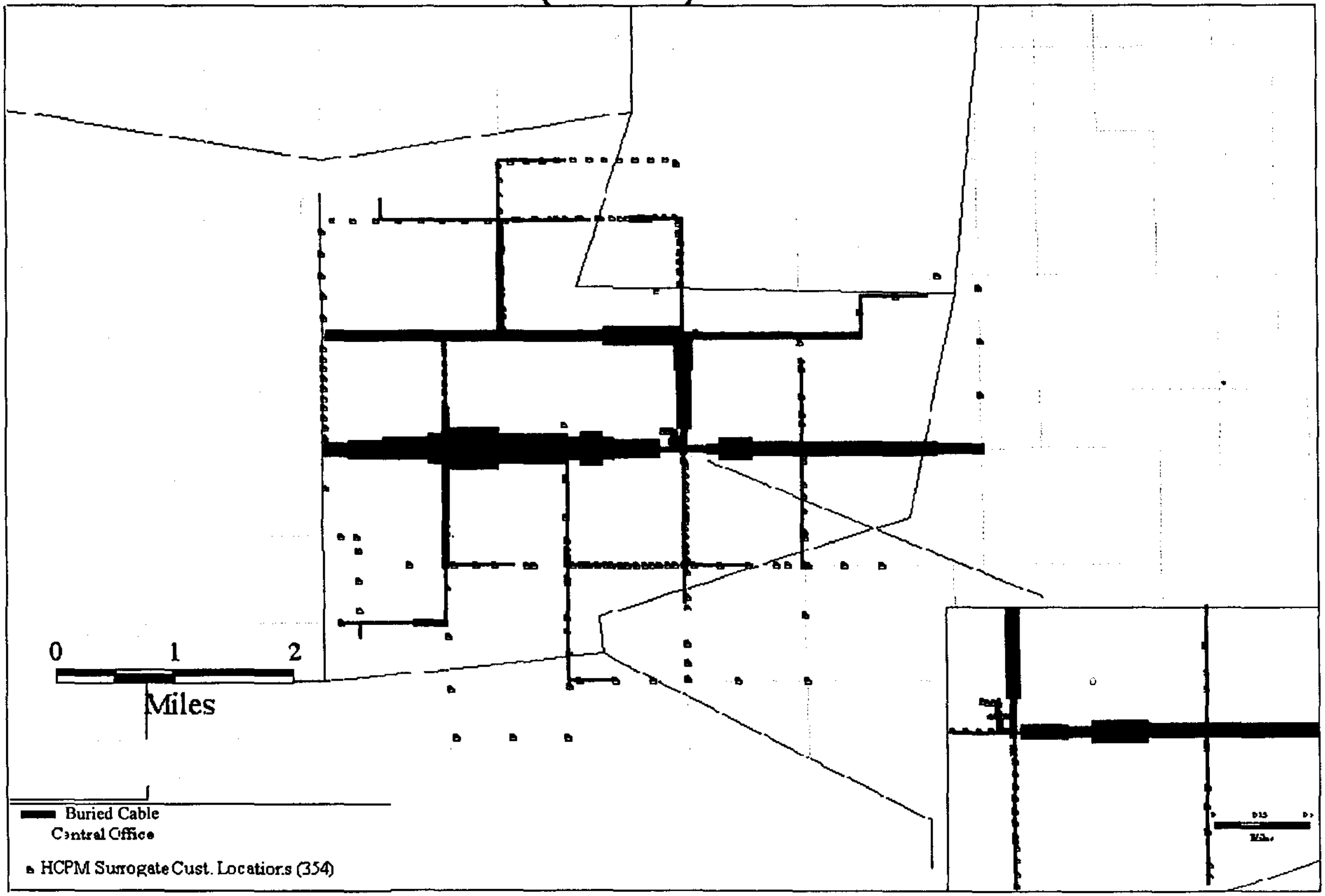
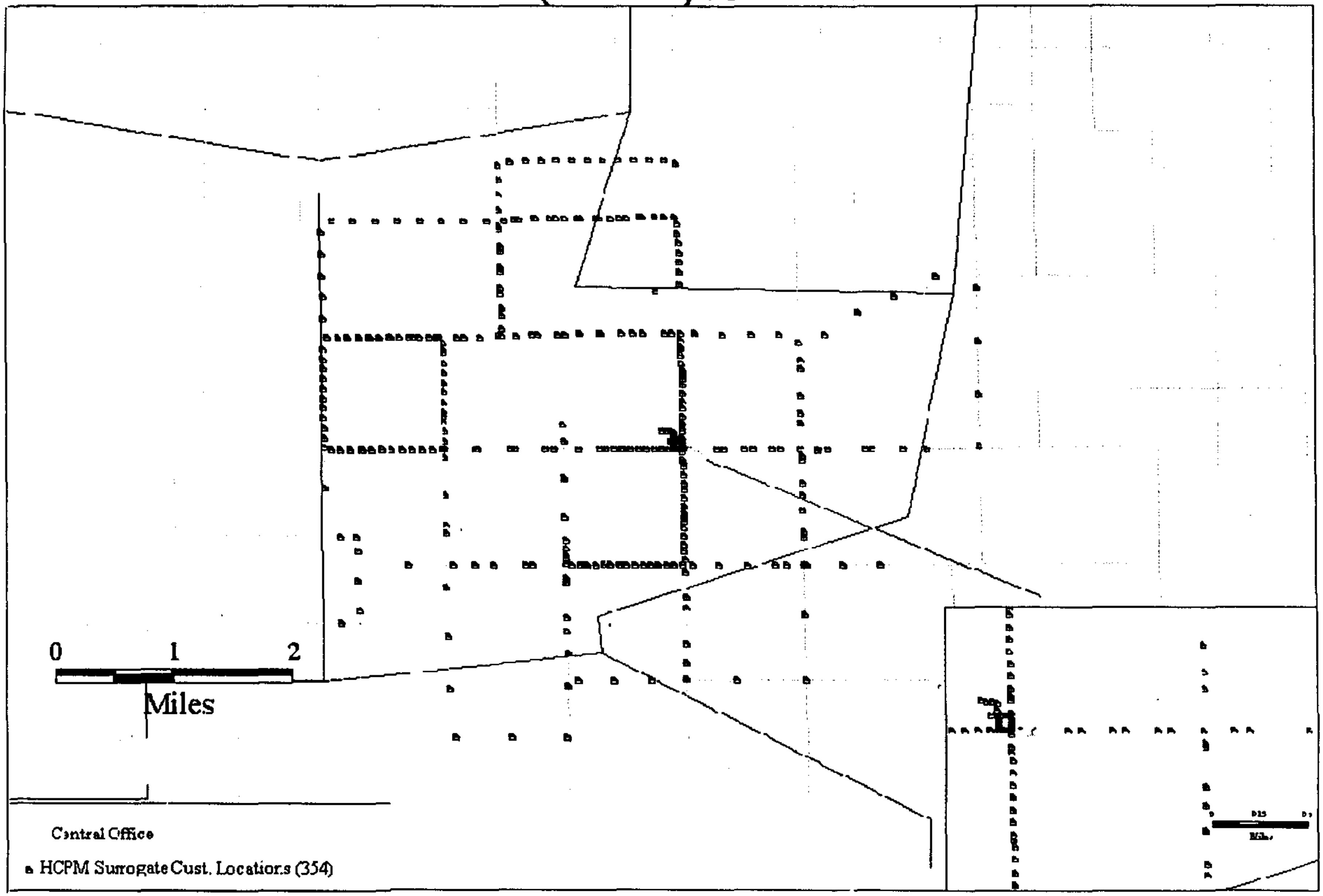
Fulton (FLTNMIN) : 367 Lines



Fulton (FLTNMIN) : 367 Lines



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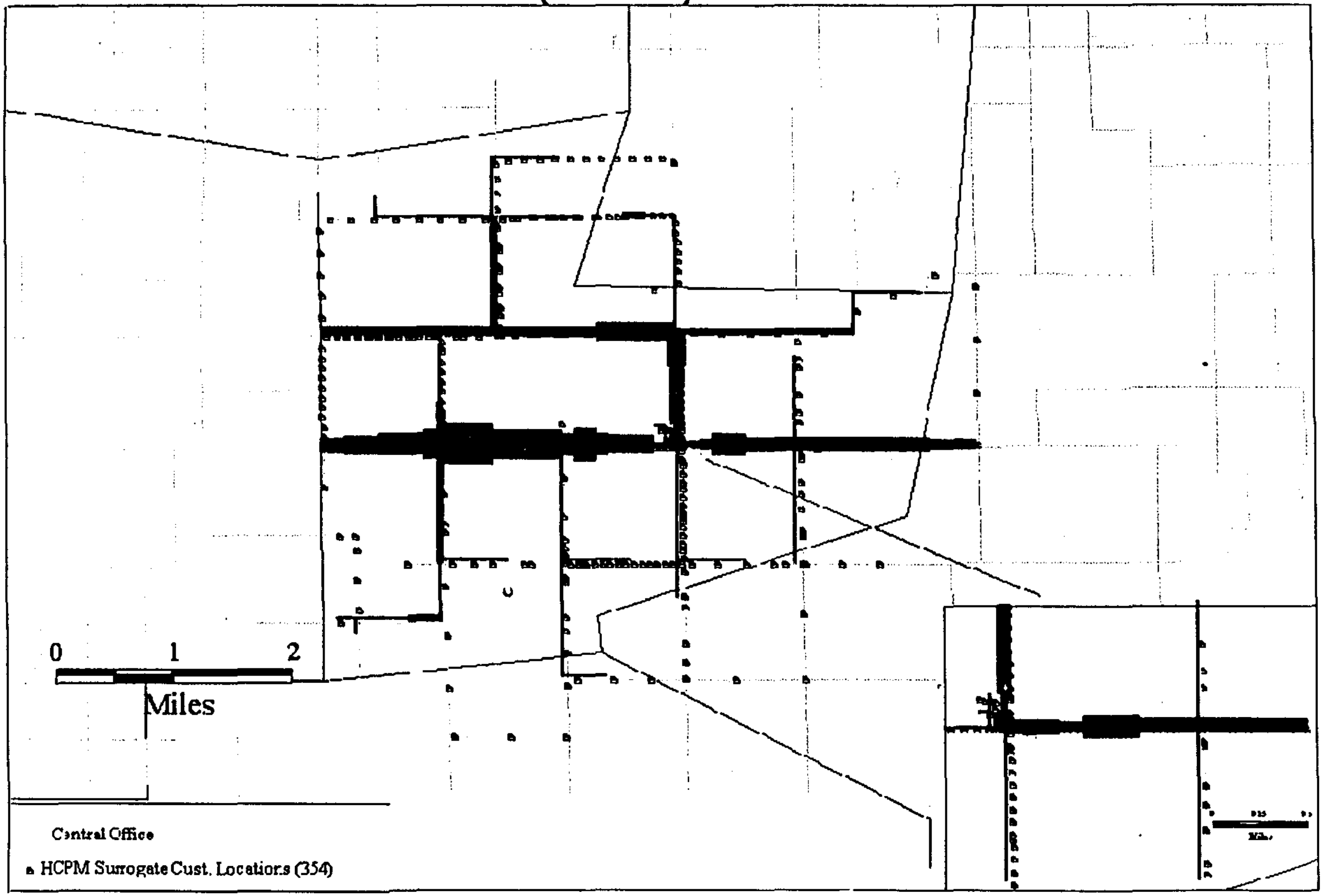
9/3/99

Fulton (FLTNMIN) : 367 Lines



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TAB 3

Detail Outputs for FLTNMIMN

Wire Center	FLTNMIMN	
Geographic Information	Number of Clusters	3
	Number of Clusters w/ 1 to 3 Lines	0
	Total Area of Clusters (Sq.Mi.)	21
	Number of Households	340
	Number of Lines	376
	Number of Residential Lines	344
	Number of Business Lines	21
	Number of Single Line Business Lines	11
	Number of Special Access Lines	11
Feeder Plant	Total Feeder Distance (ft)	25,610
	Total Feeder Cable Investment	$34,916
	U/G Feeder Cable Investment	$3,338
	Buried Feeder Cable Investment	$14,526
	Aerial Feeder Cable Investment	$17,052
	Total Feeder Placement Investment	$33,186
	U/G Feeder Placement Investment	$4,775
	Buried Feeder Placement Investment	$18,822
	Aerial Feeder Placement Investment	$9,589
Distribution Plant	Total Distribution Distance (ft)	433,307
	Total Distribution Cable Investment	$540,922
	U/G Distribution Cable Investment	$11,072
	Buried Distribution Cable Investment	$304,740
	Aerial Distribution Cable Investment	$225,111
	Total Distribution Placement Investment	$620,660
	U/G Distribution Placement Investment	$9,803
	Buried Distribution Placement Investment	$448,446
	Aerial Distribution Placement Investment	$162,411

TAB 4

Analysis of Selected Investment Inputs and Optimization Procedures in the Hybrid Cost Proxy Model (HCPM)

Presented to FCC Common Carrier Bureau Accounting Policy Division

September 9, 1999

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I. PURPOSE

1. Determine if the HCPM is consistent in its use of inputs that are related to its optimizations procedures;
2. Determine if the optimization procedures produce the expected results; and
3. Determine if the optimization procedures have significant impacts on the HCPM's cost estimates.

II. THE BASE CASE

A. Explanation Of The Inputs

The use of Pascal for the distribution and feeder modules of the HCPM significantly decreases the transparency of the model. We did not examine the Pascal code. We probed the model with a series of changes to input values. Our analysis proceeded as follows:

1. Based on relationships that should hold in the model, we designed a baseline set of inputs to test if the model is using these inputs correctly.
2. Using the baseline input values, we determined if the HCPM produces the expected cost estimates.
3. Building from the baseline, we changed selected inputs to assess the impacts on the baseline run.
4. To test the relevancy of the optimization procedures, we turned on the optimization procedures and used inputs recommended by the FCC to assess how the basic local service costs changed from the FCC's default run.

B. The Baseline

There are underlying relationships that should hold in any cost model. For example, cable investment should be the product of the route distance of plant and the cost per foot of cable. Inputs were selected for our baseline run that provide simple tests of this relationship in the HCPM. To test the HCPM model, in our baseline all cable costs were set at one dollar per foot. A foot of cable placed, therefore, should always translate into a dollar of cable investment. Below, is a description of the input changes from the FCC's recommended inputs that were made to establish the baseline.

1. **Cable costs** were set at one dollar per foot for all three types of plant (aerial, buried, and underground), for all cable sizes, for both distribution and feeder plants, and for both copper and fiber cables. If the model applies cable costs consistently, 1 foot of route distance should translate into $1 of cable investment.
2. **Placement costs** were set at one dollar per foot for all three types of plants, for all density groups, for both distribution and feeder plant, and for all three types of

soil terrain.

3. **Sharing percents** were set at 80 percent for all three types of plant and all nine density groups. If the model applies placement costs and sharing consistently, 1 foot of route distance should translate into $0.80 of placement investment.

4. **Plant mix** was set at one-third for all three types of plant, for all density groups, for both distribution and feeder plant, and for both copper and fiber plant. After excluding feeder manhole investment from the equation, the placement investment for all three types of plant should be equal.

5. **Annual charge factors** in the Excel input workbook were set at 0.2[1]. When the plant mixes do not sum to one, the model will assign the remaining plant to the category with the smallest annual cost. Since annual cost is the product of investment and the annual charge factor, the plant type that produces the smallest investment may not be selected by this optimization procedure if that plant type has a relatively large annual charge factor. Setting all annual charge factors to 0.2 ensures that this optimization should minimize based on investment rather than annual cost.

6. **Manhole costs** were set at $1,000 per duct for all duct capacities for all three types of soil terrain.

7. **Soil texture impacts** were set at 0. Since soil texture impacts can affect the calculation of placement investment, this variable was held at zero to ensure that the relationship between route distance and placement investment should hold.

8. **Maximum number of SAIs** in a distribution area was set at 1. This disables the procedure that uses more than one SAI in a distribution area to minimize cost.

9. **Prim / Minimal Cost Spanning Tree** procedure in distribution was turned off.

C. Expectations vs. Results

1. Since all cable costs are set to $1 per foot, 1 foot of route distance should translate into $1 of cable investment. The result of the baseline run shows that this relationship holds for distribution cable investment.

2. In feeder, however, the result of the baseline run shows that 1 foot of route distance produces more than $1 of cable investment. One possible cause is double strapping[2]. To eliminate the possible effect of double strapping, we performed another baseline run with the maximum copper cable size set to 20,000 and the

[1] This change does not affect the annual charge factor calculations in the Cost of Capital Calculation in the Expense Module.

[2] When the required cable between two points exceeds the maximum cable size (in the default scenario, 4,200 is the maximum cable size), the telephone company would put in two cables between these two points. This is called double strapping. Even though the model documentation does not explain whether the model accounts for this, we conducted analyses as if double strapping is being done in the model.

maximum fiber cable size set to 10,000. The result of that run still indicates that 1 foot of route distance produces more than $1 of cable investment in feeder.

Comparing Feeder Distance and Feeder Cable Investment in the Baseline Run

	Route Distance (ft)	Cable Investment	Cable Investment Per Foot of Route Distance
With Double Strapping	19,233,618	$22,308,949	$1.16
Without Double Strapping	19,233,618	$21,881,225	$1.14

3. Since all placement costs are set to $1 per foot and all sharing percentages are set to 80%, 1 foot of route distance should translate into $0.80 placement investment. This relationship does not hold for distribution or feeder placement costs. For distribution and feeder, 1 foot of route distance produces more than $0.80 of placement investment.

Comparing Route Distance and Placement Investment in Distribution and Feeder Networks in the Baseline Run

	Route Distance (ft)	Placement Investment	Placement Investment per Foot of Route Distance
Distribution	102,229,285	$109,366,177	$1.07
Feeder	19,233,618	$16,345,549	$0.85

4. Since all plant mixes are set to 1/3, placement investments for all three types of plants should be equal. This relationship holds for distribution investment, but does not hold for feeder investment.

Comparing Feeder Placement Investment By Plant Type in the Baseline Run

Feeder Placement Investment		
U/G	Buried	Aerial
$5,982,626	$5,058,686	$5,304,238

III. TESTING OPTIMIZATION 1: VARYING THE NUMBER OF SAIS IN A DISTRIBUTION AREA

A. Explanation Of The Optimization Procedure

The model design allows up to 4 SAIs in a distribution area and chooses the number of SAIs that produces the shortest total distribution distance within the distribution area.

B. Setting The Test

The value in cell B29 (Max_SAIs) of sheet "FEEDDIST" was changed from 1 to 4.

C. Expectation vs. Result

1. The expectation is that this optimization should reduce distribution distances, and, therefore, distribution cable and placement investments. The model result matches this expectation.

2. Unexpectedly, however, this optimization routine leads to a mismatch in route distance and cable investment. Even with this optimization enabled, 1 foot of distribution route distance should produce $1 of cable investment. This relationship holds in the baseline run, but it does not hold in the optimization test run, as shown below.

Comparing Distribution Distance and Distribution Cable Investment in the Test Run With Max_SAIs = 4

Route Distance (ft)	Cable Investment	Cable Investment per Foot of Route Distance
98,781,001	$100,061,033	$1.01

3. This optimization causes a relatively small reduction in the distribution distance, distribution cable investment, and distribution placement investment in low density groups, and has virtually no effect in the high density groups.

Comparing Distribution Results of Baseline Run and Test Run With Max_SAIs = 4

Density Zone	% Change from Baseline Run* Distribution Distance	Distribution Cable Investment	Distribution Placement Investment
0	(5%)	1%	(3%)
5	(9%)	(1%)	(6%)
100	(2%)	0%	(2%)
200	(2%)	1%	(1%)
650	0%	(1%)	0%
850	0%	(0%)	0%
2,550	0%	(0%)	0%
5,000	0%	(0%)	0%
10,000	0%	0%	0%
Overall	(3%)	(0%)	(2%)

* Positive means test run result is greater than baseline run result.

4. The fact that the optimization reduces cable and placement investments indicates that the model added SAIs in this test run to reduce total route distance. SAI investment in this test run, therefore, should be greater than SAI investment in the baseline run. The result, however, is counter this expectation. SAI investment in this test run equals the SAI investment in the baseline run in every density zone.

Comparing SAI Investment of Baseline Run and Test Run With Max_SAIs = 4

Density Zone	SAI investment in Baseline Run (Max_SAIs = 1)	SAI Investment in Test Run (Max_SAIs = 4)	% difference*
0	$44,396	$44,396	0%
5	$471,039	$471,039	0%
100	$347,215	$347,215	0%
200	$1,309,736	$1,309,736	0%
650	$543,605	$543,605	0%
850	$4,043,082	$4,043,082	0%
2,550	$1,673,412	$1,673,412	0%
5,000	$521,122	$521,122	0%
10,000	$156,921	$156,921	0%
Overall	$9,110,528	$9,110,528	0%

* Positive means test run result is greater than baseline run result.

D. Impact of the Optimization on the Estimated Cost of Basic Local Service

1. The table below shows a comparison of runs of the HCPM with the Max SAI set at 1, 2 (the FCC recommended input), and 4.
2. The results show that this optimization produces very small changes in the basic local service costs at the density zone and state level. With expected increases in SAI costs, that do not occur in the HCPM, it appears that the overall impact on costs would be even less.

Comparing Basic Local Service Costs of FCC Default Run and Sensitivity Runs with Max_SAIs = 1 and Max_SAIs = 4

	Basic Local Service Cost ($/Month)		
Density Zone	**Max_SAIs = 1**	**FCC Default (Max_SAIs = 2)**	**Max_SAIs = 4**
0	$204.44	$201.21	$201.21
5	$53.57	$51.58	$51.58
100	$26.25	$25.88	$25.88
200	$19.88	$19.74	$19.74
650	$18.05	$18.03	$18.03
850	$16.48	$16.46	$16.46
2,550	$14.66	$14.63	$14.63
5,000	$11.65	$11.65	$11.65
10,000	$10.52	$10.52	$10.52
Overall	$18.69	$18.55	$18.55

IV. Testing Optimization 2: Prim / Minimal Cost Spanning Tree Algorithm in Distribution

A. Explanation of the Optimization Procedure

With this optimization procedure disabled, the model builds a distribution network with vertical backbones and horizontal branch cables. With this optimization procedure enabled, the model builds distribution plant according to the Minimal Cost Spanning Tree algorithm.[3]

B. Setting The Test

We enable the optimization procedure by changing cell B5 in sheet "INTRFACE".

C. Expectation vs. Result

1. Because 1 foot of route distance should produce $1 of cable investment and $0.80 of placement investment, this optimization routine must reduce the cable and placement investments by reducing route distance in each distribution area. In the test run, the HCPM does reduce distribution distance.

[3] Aside from the mechanical problems associated with the application of the Minimum Spanning Tree (MST) within the HCPM, there are reasons why this process should not be used to design distribution facilities in a cost proxy model. Distribution facilities are not designed according to the MST, and to our knowledge, there are no definitive studies that establish functional relationships between actual cable distances (including drops) and MST distances. At best, the MST provides a diagnostic tool (reality check) for assessing the lower level of reasonableness for distribution distances.

2. Contrary to expectation, however, this optimization routine leads to a mismatch in route distance and cable investment. Even with this optimization enabled, 1 foot of distribution route distance should produce one $1 of cable investment. This relationship holds in the baseline run, but it does not hold in the test run, as shown below.

Comparing Distribution Distance and Distribution Cable Investment in the Test Run With PRIM / MCST in Distribution On

Route Distance (ft)	Cable Investment	Cable Investment per Foot of Route Distance
96,425,233	$100,851,009	$1.05

3. The optimization reduces distance and placement investment by 11 and 15 percent in density zones 1 and 2, has very little effect in density zones 3 to 4, and has almost no effect in density zones 5 to 9.

Comparing Distribution Results of Baseline Run and Test Run With PRIM / MCST in Distribution On

Density Zone	% Change from Baseline Run*		
	Distribution Distance	Distribution Cable Investment	Distribution Placement Investment
0	(11%)	(0%)	(11%)
5	(15%)	(0%)	(15%)
100	(3%)	(0%)	(3%)
200	(1%)	(0%)	(1%)
650	(0%)	0%	(0%)
850	(0%)	0%	(0%)
2,550	0%	0%	0%
5,000	0%	0%	0%
10,000	0%	0%	0%
Overall	(6%)	(0%)	(6%)

* Positive means test run result is greater than baseline run result.

D. Impact of the Optimization on the Estimated Cost of Basic Local Service

1. The impact of this optimization on the estimated cost of basic local service was tested by comparing a run of the model with the optimization routine turned on and off for all density zones, holding all other inputs at the FCC's recommended values.

2. The result of this sensitivity run shows that the optimization reduces the basic local service costs for the two lowest density group by approximately 4%, and has little to no effect on the basic local service costs for the other density groups.

Comparing Basic Local Service Costs of FCC Default Run and Sensitivity Run with Distribution PRIM / MCST On

Density Zone	Basic Local Service Cost ($/Month)		
	FCC Default	Distribution PRIM / MCST On	% Change From FCC Default*
0	$201.21	$193.02	(4%)
5	$51.58	$49.64	(4%)
100	$25.88	$25.50	(1%)
200	$19.74	$19.64	(0%)
650	$18.03	$18.00	(0%)
850	$16.46	$16.44	(0%)
2,550	$14.63	$14.61	(0%)
5,000	$11.65	$11.65	(0%)
10,000	$10.52	$10.52	(0%)
Overall	$18.55	$18.41	(1%)

* Positive means sensitivity run result is greater than the FCC default run result.

V. Testing Optimization 3: Prim / Minimal Cost Spanning Tree Algorithm in Feeder

A. Explanation Of The Optimization Procedure

The model builds the feeder plant according to the Minimal Cost Spanning Tree algorithm. Since this optimization procedure is the only algorithm in the feeder module, it cannot be turned off.

B. Concerns

1. The complexity of the optimization algorithm and the lack of transparency of the model make it very difficult to design a test of the consistency or impact of the procedure.

2. In all test runs, the expected relationships between feeder distance and feeder

cable and placement investments do not hold. This error in the feeder design does not engender confidence in the overall feeder design, including the use of the PRIM / MCST algorithm.

3. FCC recommends using 1.00 as the distribution and feeder road factor, which converts air or rectilinear distances into route distances. This leads to the assumption that the HCPM is using rectilinear distances, for which the FCC believes that the road factor should be between 0.95 and 1.05. (See footnote 24 of the Overview of Version 2.6 of the HCPM, December 26, 1998.)

VI. Testing Optimization 4: Copper, T1 or Fiber Selection in Feeder

A. Explanation Of The Optimization Procedure

In the feeder module, the HCPM selects among analog copper, digital copper (T1), and fiber to minimize cost.

B. Setting Two Test Runs

1. All fiber cable costs were set at $3 per foot (i.e., 3 times of the fiber cable costs in the baseline run); and
2. All fiber cable costs were set to $10 per foot (i.e., 10 times of the fiber cable costs in the baseline run).

C. Expectation vs. Result

1. In the first test run, the increase in fiber cable costs should lead to some substitution of fiber cables with either analog copper or T1 cables in the feeder module. Copper feeder cable investment in the test run, therefore, should be greater than in the baseline run; and the fiber feeder cable investment in the test run should be less than 3 times the amount in the baseline run. The results do not match these expectations. Copper feeder cable investment in the test run is virtually the same as in the baseline run, and fiber feeder cable investment in the test run is slightly greater than 3 times the amount in the baseline run.
2. The fact that the fiber cable investment in this test run is approximately 3 times of that figure in the baseline run suggests that this optimization procedure has very little effect on reducing cable investment.
3. The second test run provides similar results, as shown below.

Comparing Cable Investment from the Baseline Run and Test Run With Fiber Cable Cost = $10/ft

% Change in Copper Cable Investment From the Baseline Run*	% Change in Fiber Cable Investment From Baseline Run *
0%	923%

* Positive means test run result is greater than baseline run result.

VII. TESTING OPTIMIZATION 5: PLANT MIX

A. Explanation Of The Optimization Procedure

When the plant mixes do not sum to 1, the model assigns the missing percent of plant to minimize cost.

B. Setting the Tests

1. Test 1: all plant mixes were set at 25% (i.e., 25% short of 1).
2. Test 2: all plant mixes were set at 10% (i.e., 70% short of 1).

C. Expectation Vs. Result

1. In both test runs, the distribution module should build the same distribution network as the baseline run. Total distribution distance in each density group in both runs should be equal to the distances in the baseline run. Furthermore, 1 foot of route distance should still translate to $1 in cable investment and $0.80 in placement investment. Cable investment and placement investment in each density group in both runs, therefore, should be equal to their values in the baseline run. These relationships hold in both test runs.
2. In both test runs the HCPM designates all of the missing distribution plant as buried.
3. In feeder, since u/g placement includes manholes, the expectation is that the HCPM will designate the missing plant as buried or aerial. In our test runs, all missing plant was designated as buried. The results are, therefore, in line with expectation.
4. Because test 2 has more "free" plant to assign than test 1, the expectation is that test 2 will result in a greater reduction in feeder placement investment than test 1. The result matches this expectation. In test 1, the optimization reduces the average feeder placement investment by 11%. In test 2, the optimization reduces

average feeder placement investment by 27%.

5. Note: The FCC does not turn this optimization procedure on in its default run of the model. Due to real world restrictions on the use of aerial cable, such as municipal restrictions and business decisions related to the susceptibility of aerial cable to failure, the optimization routine is of limited practical value.

D. **Impact of the Optimization on the Estimated Cost of Basic Local Service**

1. The FCC recommended default inputs are used as the starting point for the tests of the impact of the plant mix optimization procedure. For the test, plant mixes were set at 90 percent of the FCC recommended values for distribution and feeder, copper and fiber, and all density groups. For each density group, therefore, the plant mix sums to 0.9.
2. In the second sensitivity run, all plant mix inputs were set equal to 80 percent of the FCC's recommended inputs. For each density group, therefore, the plant mix sums to 0.8.
3. In these two sensitivity runs the optimization produces very small changes in the basic local service costs across density groups and in total.

Comparing Basic Local Service Costs of FCC Default Run and Sensitivity Runs with Total Plant Mix = 90% and Total Plant Mix = 80%

	Basic Local Service Cost ($/Month)		
Density Zone	**FCC Default**	**Total Plant Mix = 90%**	**Total Plant Mix = 80%**
0	$201.21	$202.77	$204.17
5	$51.58	$51.30	$51.04
100	$25.88	$25.81	$25.74
200	$19.74	$19.70	$19.67
650	$18.03	$17.99	$17.95
850	$16.46	$16.41	$16.35
2,550	$14.63	$14.57	$14.50
5,000	$11.65	$11.59	$11.53
10,000	$10.52	$10.46	$10.40
Overall	$18.55	$18.49	$18.43

VIII. OPTIMIZATIONS NOT TESTED

We have yet to devise tests for the following optimizations. The second and third optimizations listed below take place in the clustering procedure and will, therefore, be very difficult to test.

A. Splicing Two Cables Or Run Multiple Cables At Junction Points

B. Trade-Off Between Feeder And Distribution By Using Different Grid Size

C. Optimizations Procedures In Clustering

IX. SUMMARY

The following table summarizes findings in the analyses of the optimization procedures in the Synthesis Model.

Summary of Findings in Analyses of Optimization Procedures

Optimization Procedures	Advocated By the FCC	Works Consistently	Has Significant Impact On Cost
Varying Number of SAIs to Reduce Distribution Distance	Yes	No	No
PRIM / MCST Algorithm in Distribution	No	No	Some Impact On Low DZs
PRIM / MCST Algorithm in Feeder	Yes	Not Investigated / Doubtful	Not Investigated
Assigning Plant Mix Optimally When Total Plant Mix < 1	No	Yes	No
Selecting Fiber/Copper/T1 Optimally	Yes	No	Not Investigated / Doubtful
Splicing Cable or Running Multiple Cable at Junction Point	Yes	Not Investigated	Not Investigated